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			5c. PROGRAM ELEMENT NUMBER 611102		
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14. ABSTRACT The stochastic gradient decent algorithm is the now the "algorithm of choice" for very large machine learning problems. We introduced the idea of "stochastic modified equation" to the analysis of such algorithms. This approach allows us to obtain very precise information about the behavior of the algorithm. At the same time, we were also able to formulate various acceleration techniques in precise math terms (e.g. formulate them as stochastic control problems) and obtain					
15. SUBJECT TERMS stochastic gradient decent,					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT UU	15. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON Weinan E
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Report Title

Final Report: Stochastic Models of Polymer Systems

ABSTRACT

The stochastic gradient decent algorithm is the now the "algorithm of choice" for very large machine learning problems. We introduced the idea of "stochastic modified equation" to the analysis of such algorithms. This approach allows us to obtain very precise information about the behavior of the algorithm. At the same time, we were also able to formulate various acceleration techniques in precise math terms (e.g. formulate them as stochastic control problems) and obtain precise information about these acceleration methods. This approach is quite general and applies to other stochastic algorithms

Enter List of papers submitted or published that acknowledge ARO support from the start of the project to the date of this printing. List the papers, including journal references, in the following categories:

(a) Papers published in peer-reviewed journals (N/A for none)

<u>Received</u>	<u>Paper</u>
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TOTAL:

Number of Papers published in peer-reviewed journals:

(b) Papers published in non-peer-reviewed journals (N/A for none)

<u>Received</u>	<u>Paper</u>
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09/05/2013	4.00	Weinan E, Hao Shen. Mean field limit of a dynamical model for polymer systems, Science China Mathematics, (11 2012): 0. doi:
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TOTAL: 1

Number of Papers published in non peer-reviewed journals:

(c) Presentations

The dynamics of stochastic gradient algorithms (submitted);
Noisy Hegselmann-Krause Systems: Phase Transition and the 2R-Conjecture (submitted);

Number of Presentations: 1.00

Non Peer-Reviewed Conference Proceeding publications (other than abstracts):

Received Paper

TOTAL:

Number of Non Peer-Reviewed Conference Proceeding publications (other than abstracts):

Peer-Reviewed Conference Proceeding publications (other than abstracts):

Received Paper

TOTAL:

Number of Peer-Reviewed Conference Proceeding publications (other than abstracts):

(d) Manuscripts

Received Paper

02/19/2013 3.00 Weinan E, Arnulf Jentzen, Hao Shen. Wick ordered Gaussian process and the well-posedness of the stochastic Ginzburg-Landau equation, Communications in Math Physicse (02 2013)

TOTAL: 1

Number of Manuscripts:

Books

Received Book

TOTAL:

Received Book Chapter

TOTAL:

Patents Submitted

Patents Awarded

Awards

SIAM von Karman Prize

Graduate Students

<u>NAME</u>	<u>PERCENT SUPPORTED</u>	Discipline
Hao Shen	0.50	
FTE Equivalent:	0.50	
Total Number:	1	

Names of Post Doctorates

<u>NAME</u>	<u>PERCENT SUPPORTED</u>	
Hao Shen	1.00	
FTE Equivalent:	1.00	
Total Number:	1	

Names of Faculty Supported

<u>NAME</u>	<u>PERCENT SUPPORTED</u>	National Academy Member
Weinan E	0.30	
FTE Equivalent:	0.30	
Total Number:	1	

Names of Under Graduate students supported

<u>NAME</u>	<u>PERCENT SUPPORTED</u>
FTE Equivalent:	
Total Number:	

Student Metrics

This section only applies to graduating undergraduates supported by this agreement in this reporting period

The number of undergraduates funded by this agreement who graduated during this period: 0.00

The number of undergraduates funded by this agreement who graduated during this period with a degree in science, mathematics, engineering, or technology fields:..... 0.00

The number of undergraduates funded by your agreement who graduated during this period and will continue to pursue a graduate or Ph.D. degree in science, mathematics, engineering, or technology fields:..... 0.00

Number of graduating undergraduates who achieved a 3.5 GPA to 4.0 (4.0 max scale):..... 0.00

Number of graduating undergraduates funded by a DoD funded Center of Excellence grant for Education, Research and Engineering:..... 0.00

The number of undergraduates funded by your agreement who graduated during this period and intend to work for the Department of Defense 0.00

The number of undergraduates funded by your agreement who graduated during this period and will receive scholarships or fellowships for further studies in science, mathematics, engineering or technology fields:..... 0.00

Names of Personnel receiving masters degrees

<u>NAME</u>
Total Number:

Names of personnel receiving PHDs

<u>NAME</u>
Hao Shen
Total Number:

Names of other research staff

<u>NAME</u>	<u>PERCENT SUPPORTED</u>
FTE Equivalent:	
Total Number:	

Sub Contractors (DD882)

Inventions (DD882)

Scientific Progress

(1) We introduced a new approach to analyze the algorithms for big data applications. (2) We studied stochastic dynamics of polymer systems in the mean field limit. (3) We studied noisy Hegselmann-Krause systems, their phase transition and we gave strong evidence for the so-called 2R-Conjecture.

Technology Transfer